Autogenous development of habitat heterogeniety in the Okavango Delta, northern Botswana

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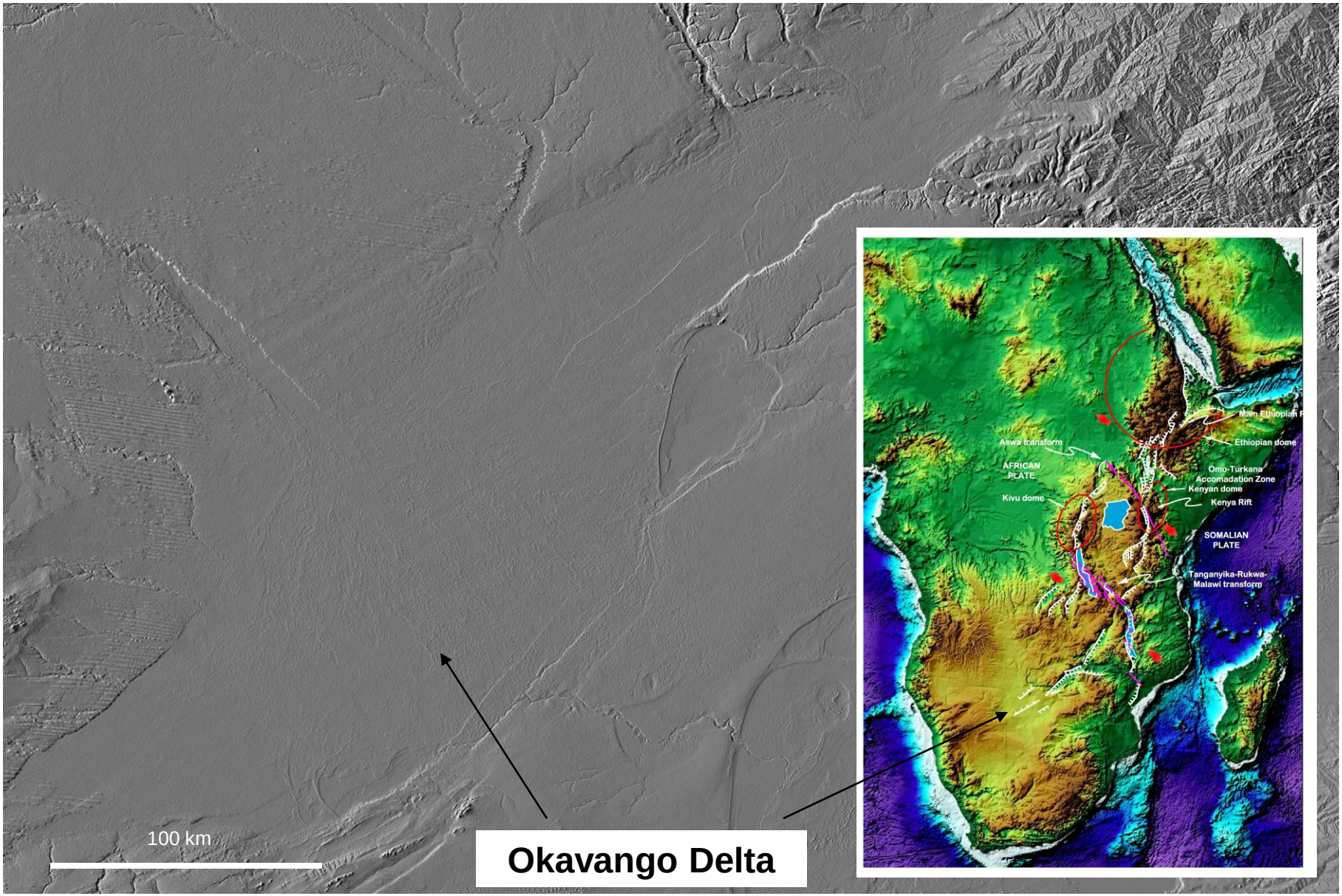
University of the Witwatersrand and Rhodes University, South Africa



SRTM image – Gordon Cooper

Comparative sizes of the Okavango and the historic Everglades

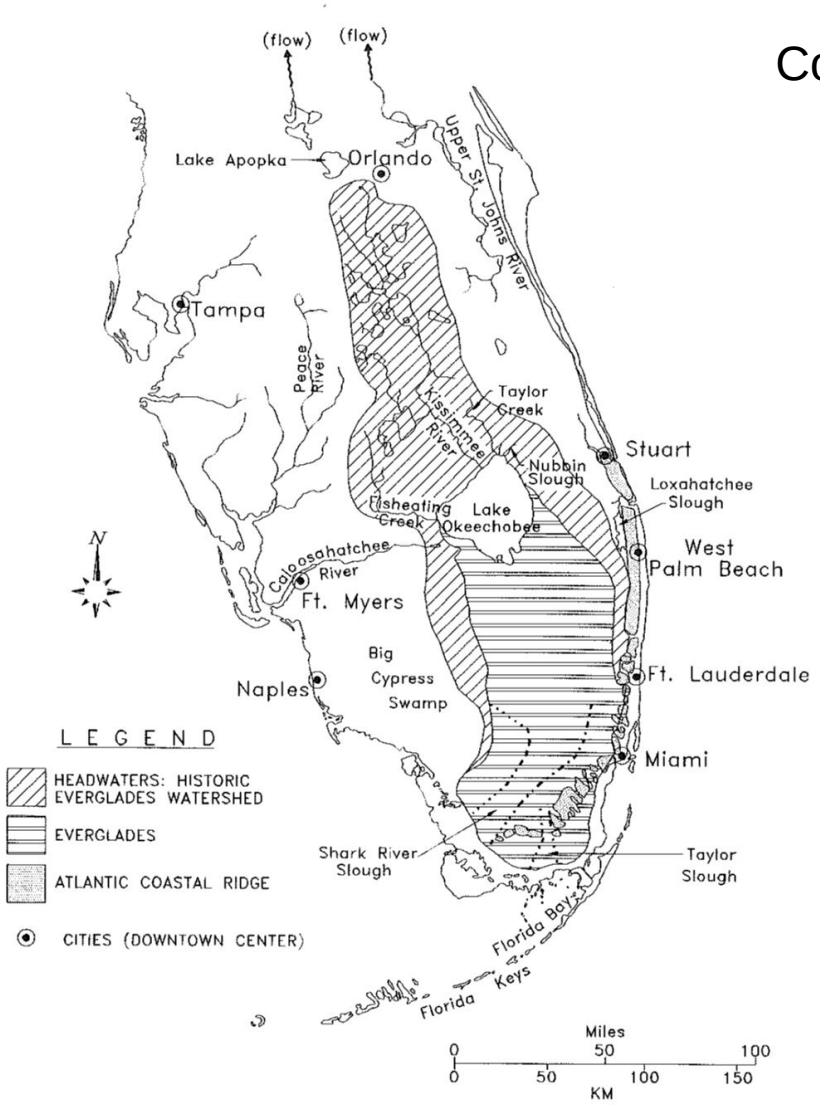
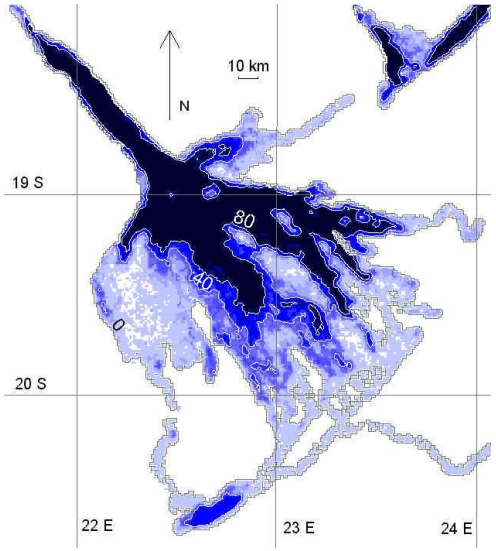


FIGURE 2.2
Map of the historic Everglades watershed.

(T E Lodge The Evergaldes Handbook)

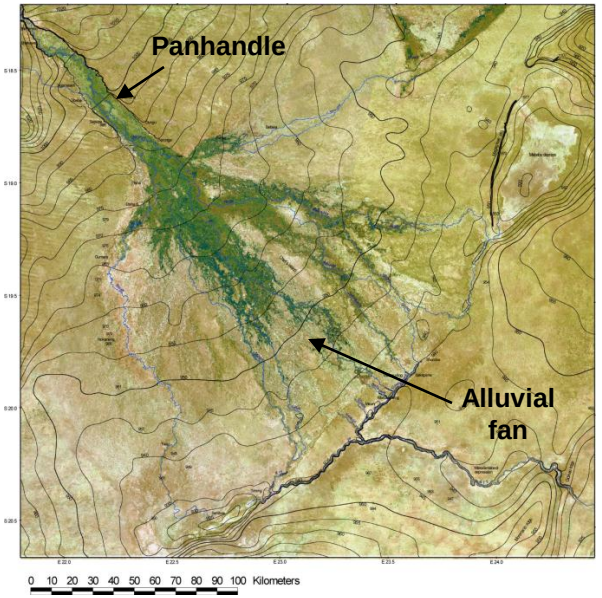


Inundation frequency of the Okavango Delta

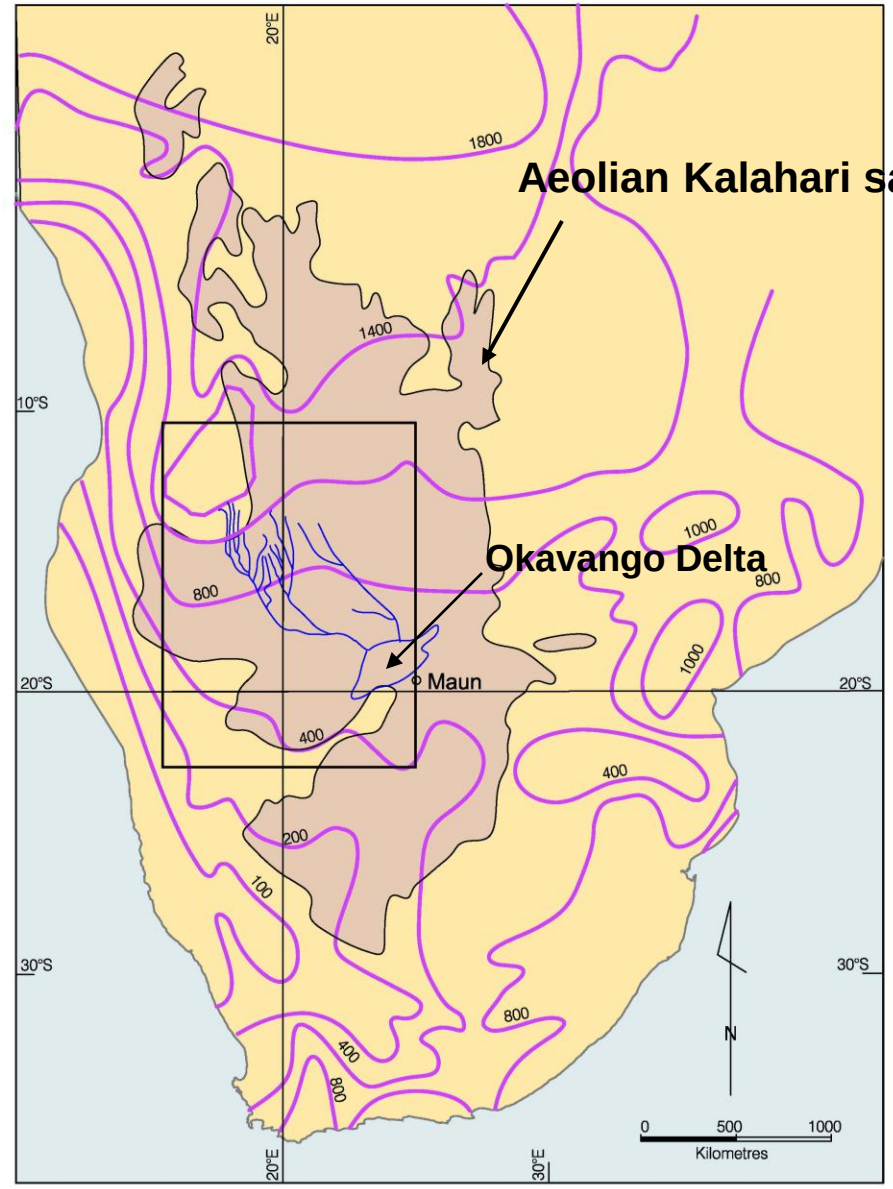
The Okavango Alluvial Fan

Fan gradient : 65 m fall in 250 km

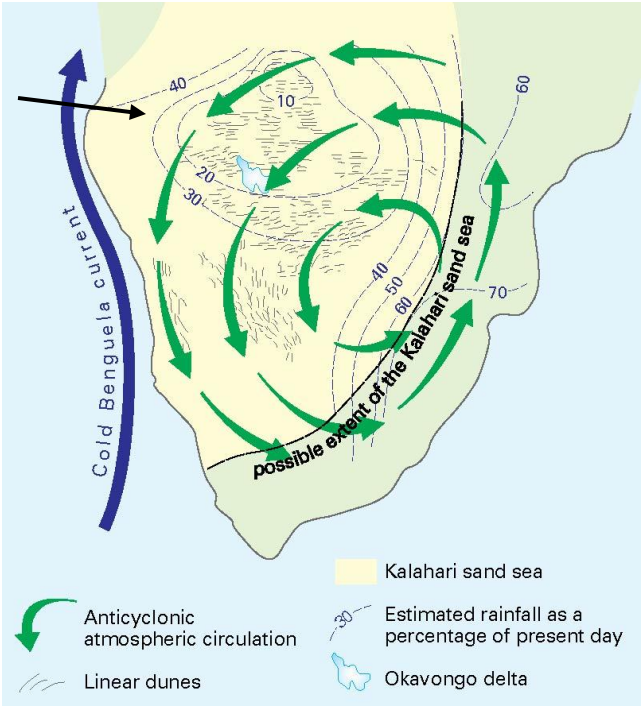
Fan surface extremely smooth



Source of the water



Present climate

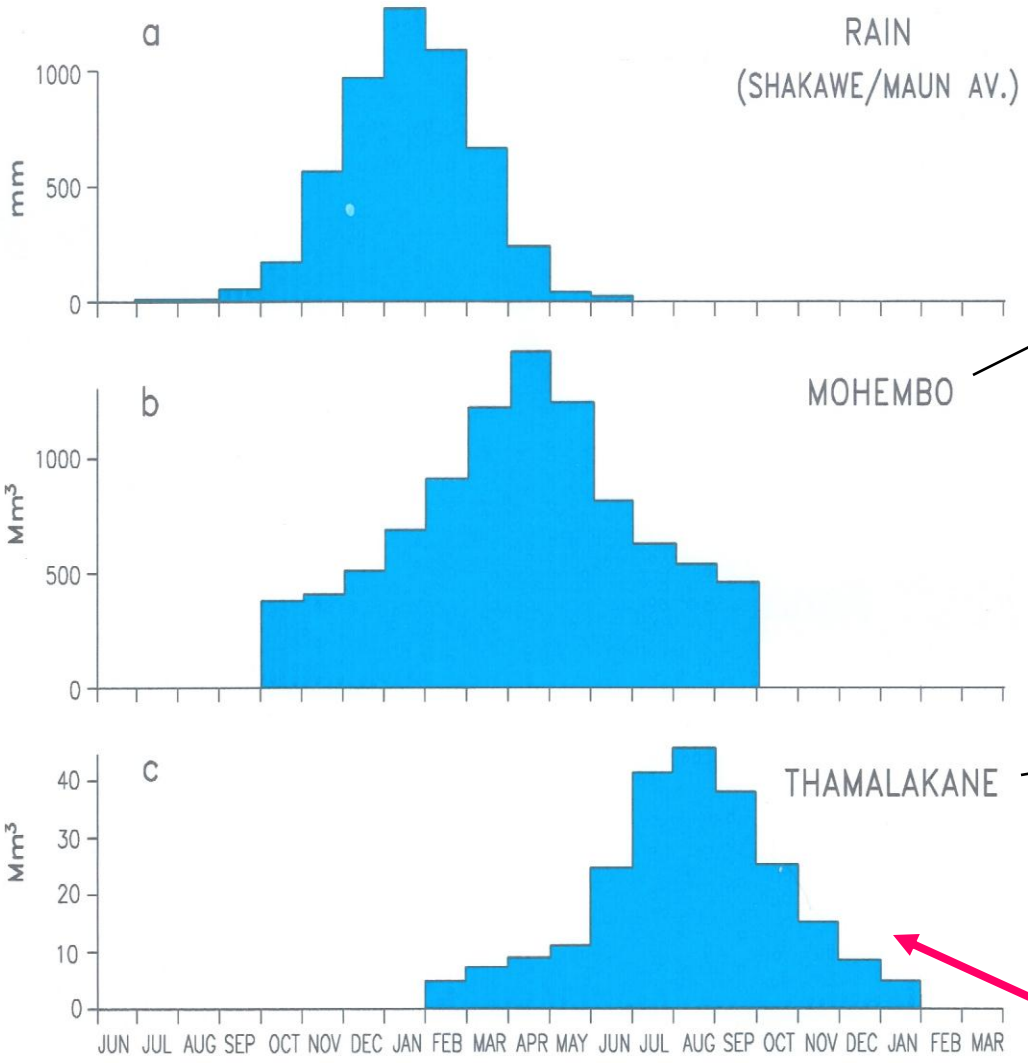


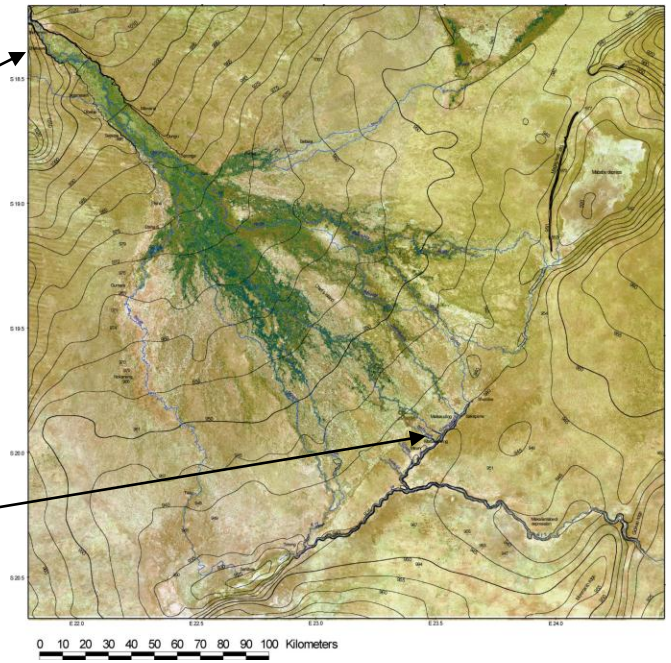
Ice age climate

Delta climate is semi-arid:

Evaporation = 5 x rainfall

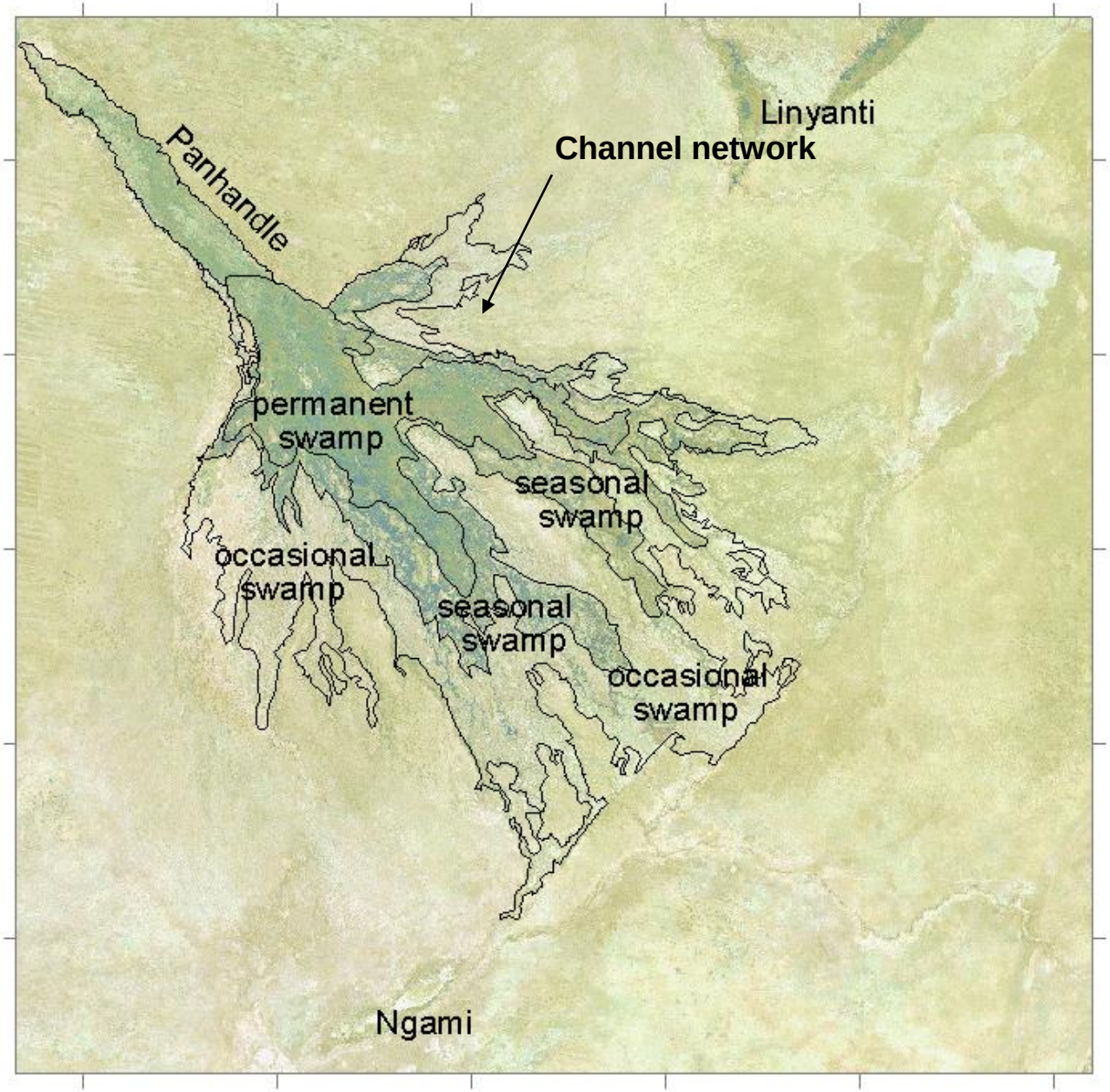
Hydrology





Only 2% of inflow plus rainfall leaves as surface outflow

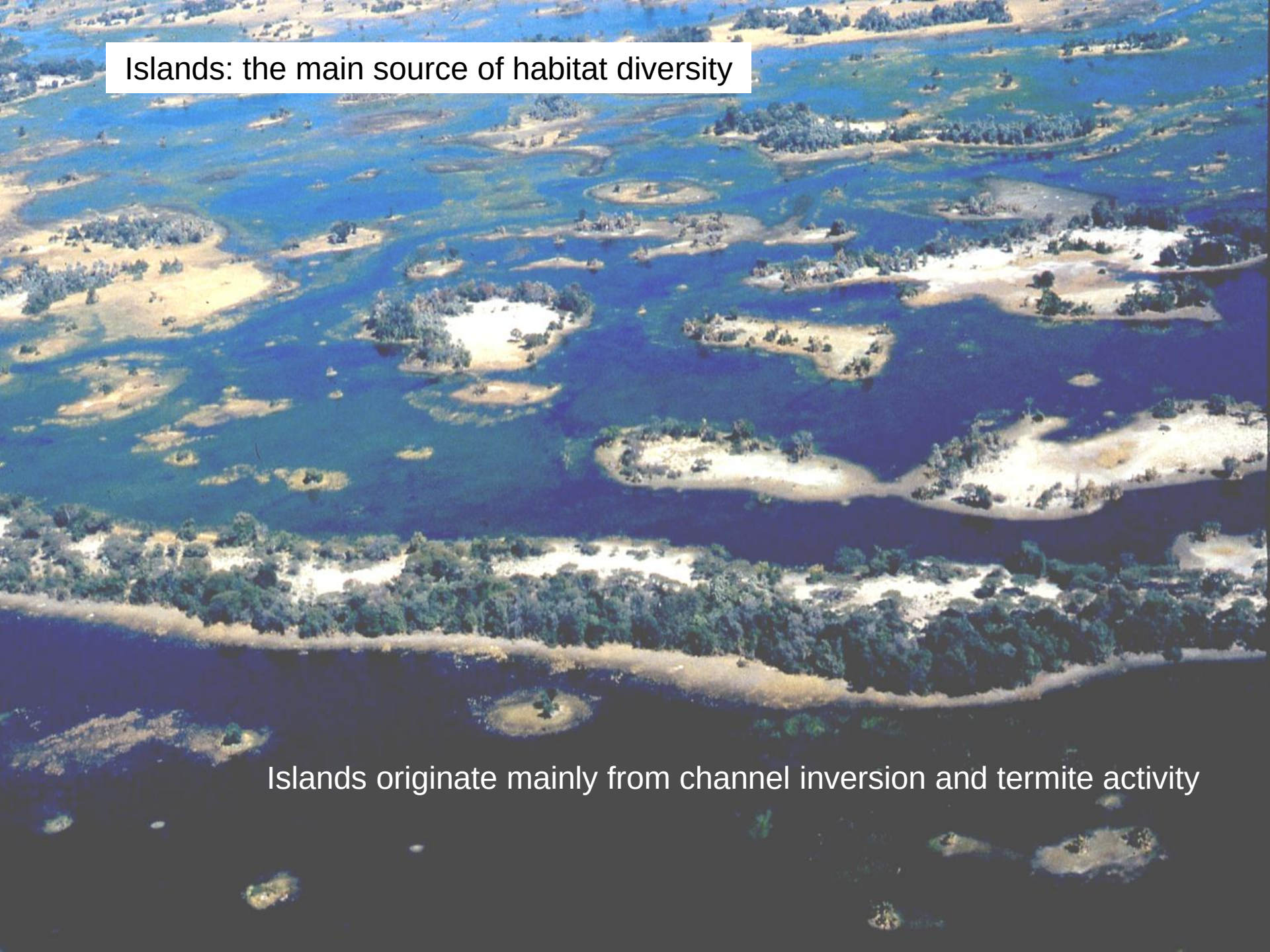
Distribution of swamps



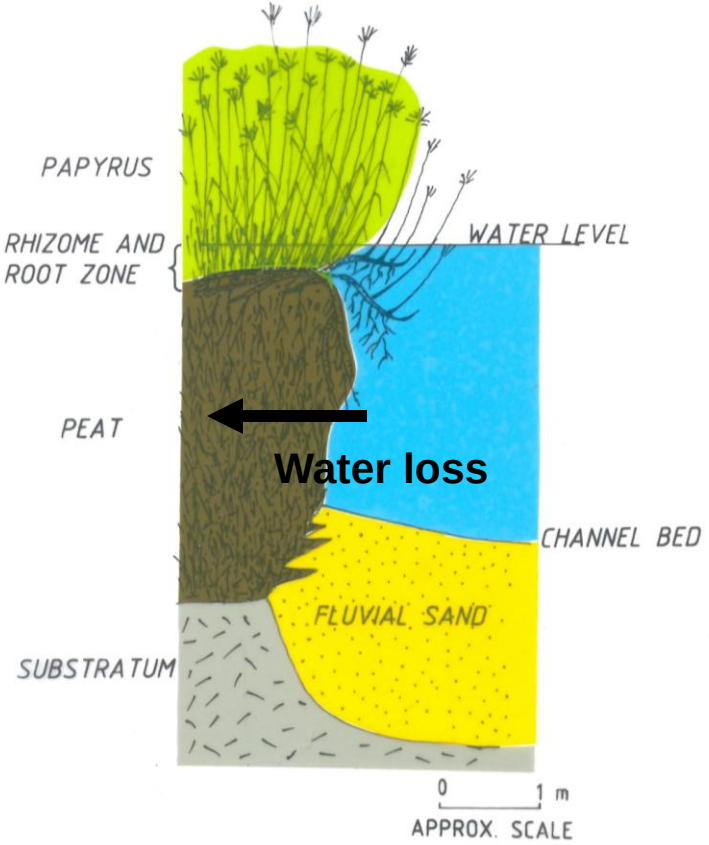
Important features of Okavango water and sediment

* very low in mud and silt
* very low in dissolved solids – but chemical precipitates are the dominant sediment type
* very low in nutrients

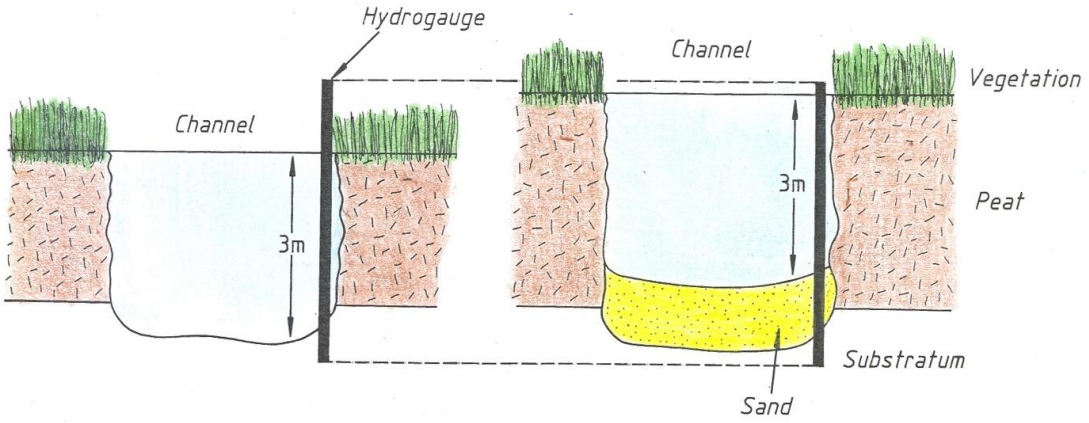
	INFLOW	SURFACE OUTFLOW
WATER		
Rainfall	6.14×10^9 m^3	
Okavango Inflow	9.2×10^9 m^3	0.24×10^9 m^3
SEDIMENT		
Bedload	170 000 t	nil
Suspended load	39 000 t	nil
Solute load	381 100 t	23 450 t
SOLUTE LOAD COMPOSITION		
CaCO3	114 900 t	5310 t
MgCO3	19 100 t	1640 t
SiO2	147 000 t	8300 t
NaHCO3	67 100 t	5600 t
KHCO3	33 100 t	2600 t
Aerosol fallout	250 000 t	

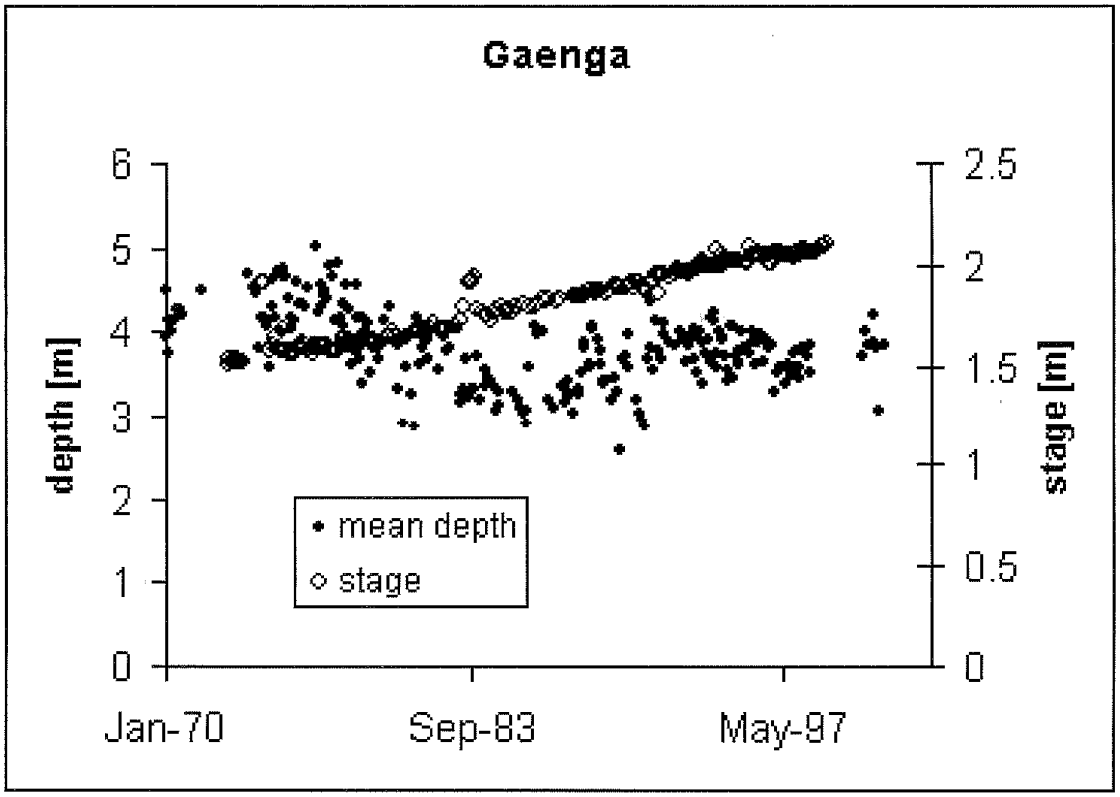

Islands: the main source of habitat diversity
Islands originate mainly from channel inversion and termite activity

Channel inversion



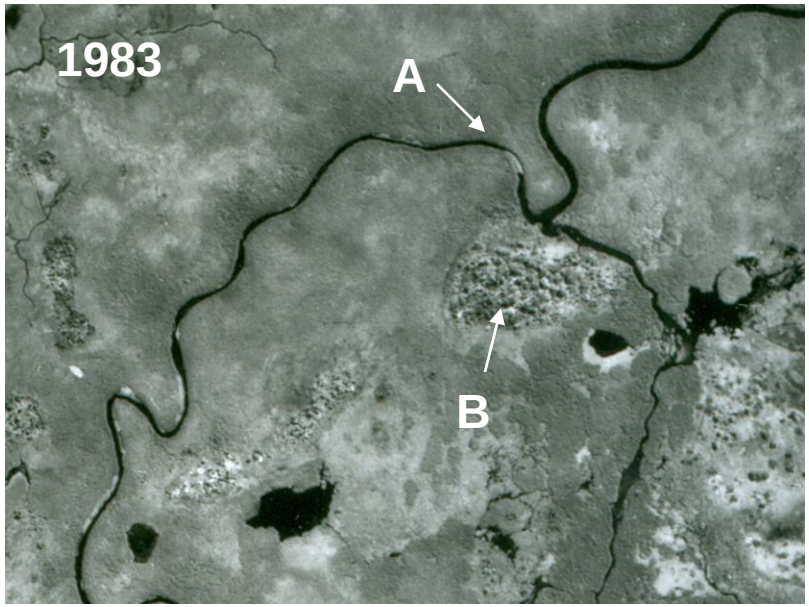
SEDIMENT		
Bedload	170 000 t	nil
Suspended load	39 000 t	nil

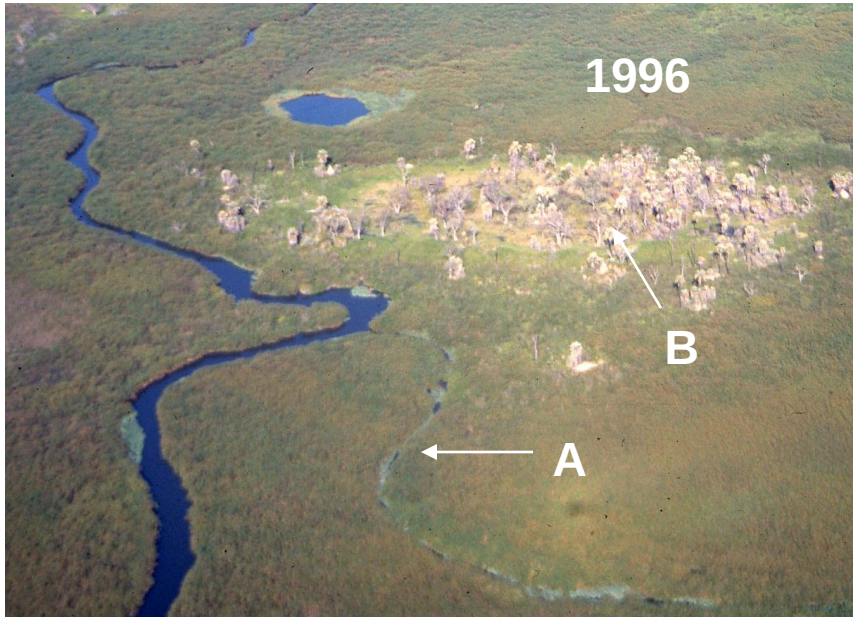


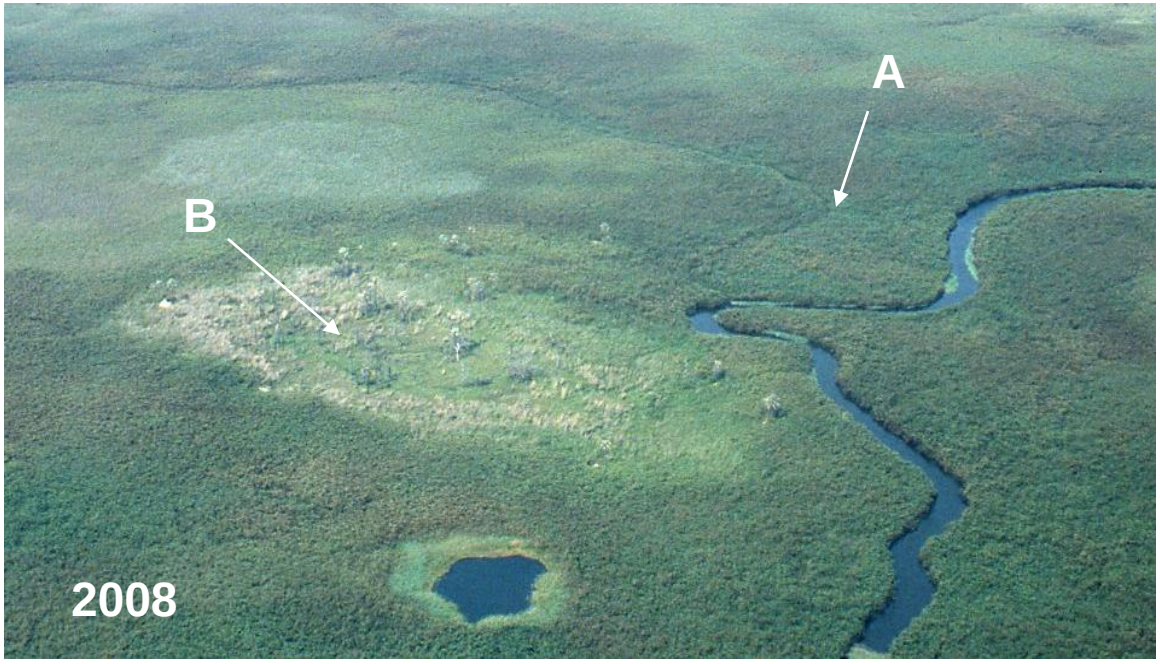


Channel failure on the fan

Piotr Wolski

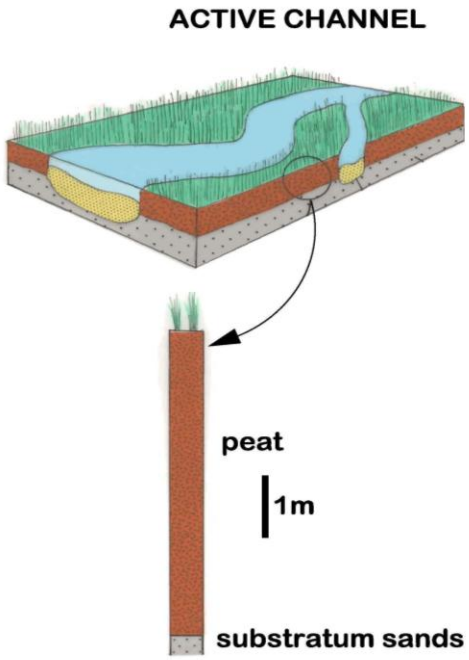

1983
A
B

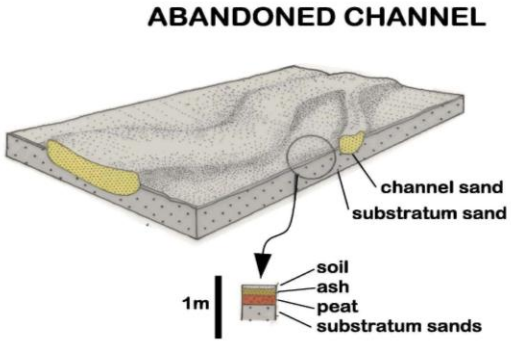

1996
B
A

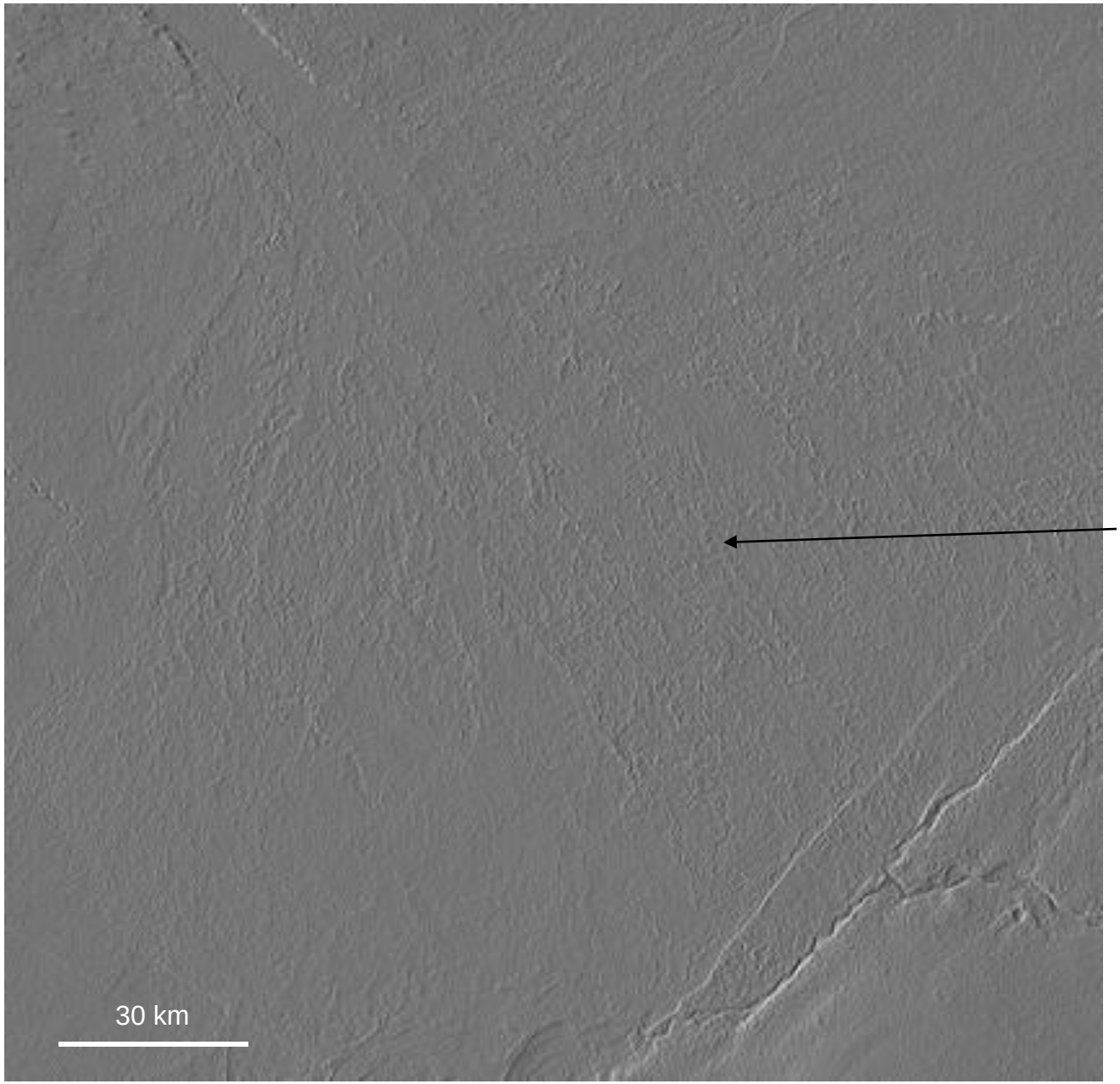

A
B
2008


New channels nucleating on hippo trails
Aggrading sediment-bearing channel
Image © 2012 GeoEye
2.86 mi
Google earth
Imagery Date: 10/17/2011
19°02'31.03" S 22°38'08.49" E elev 3191 ft
Eye alt 13.00 mi

Peat fires

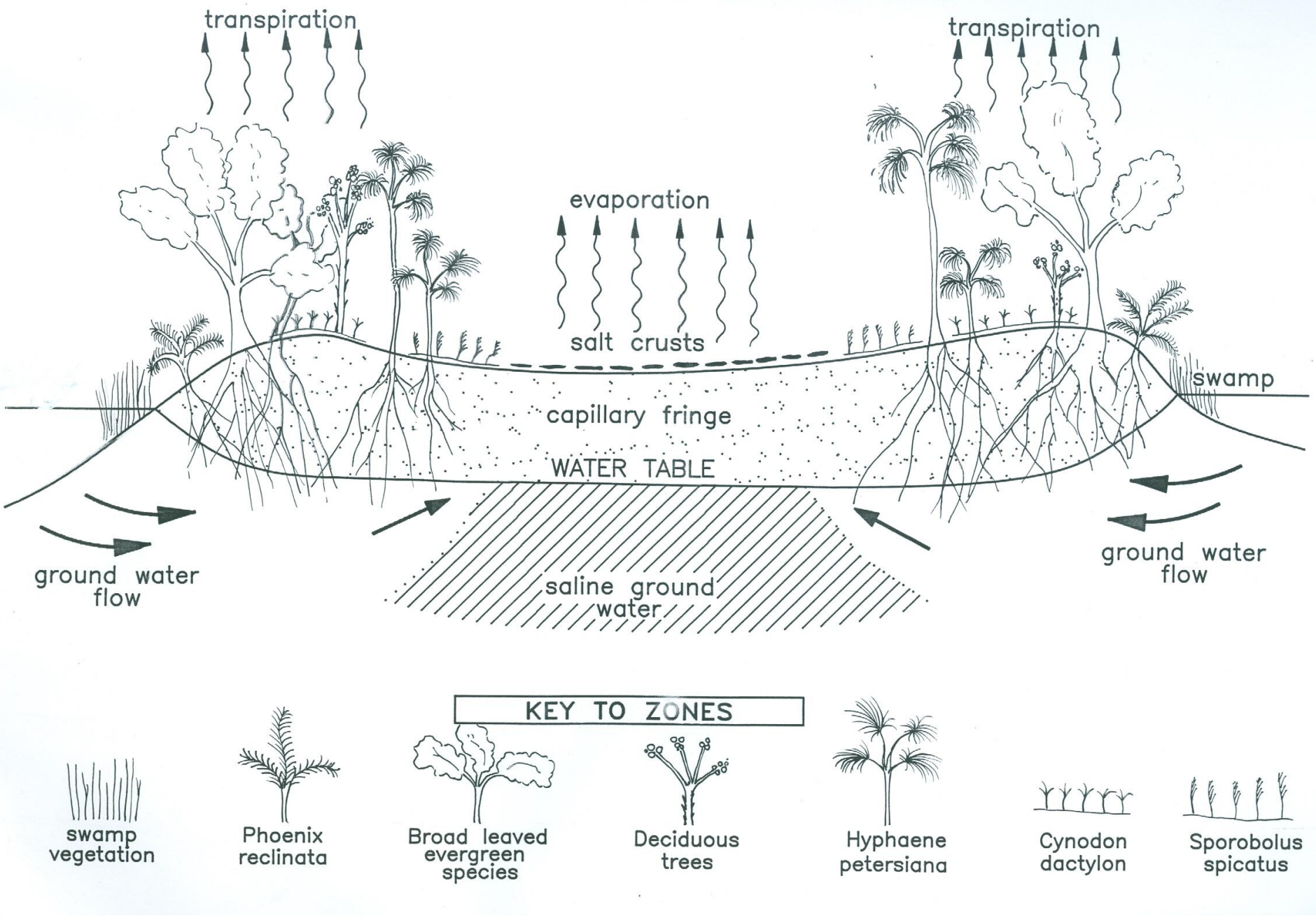

ACTIVE CHANNEL
peat
1m
substratum sands

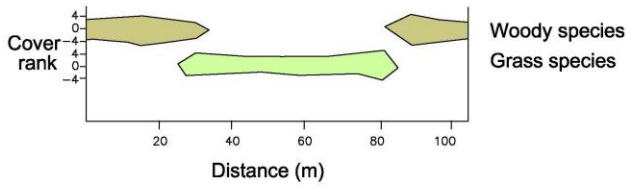

ABANDONED CHANNEL
channel sand
substratum sand
1m
soil
ash
peat
substratum sands

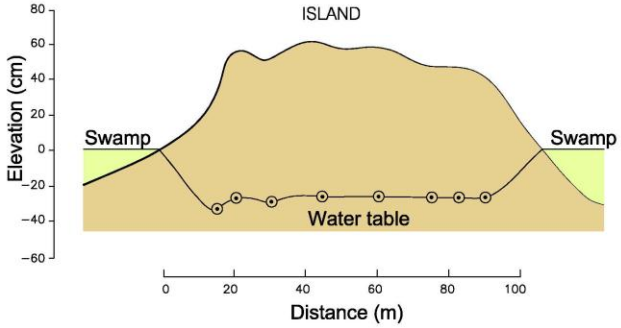

Inverted channels
30 km

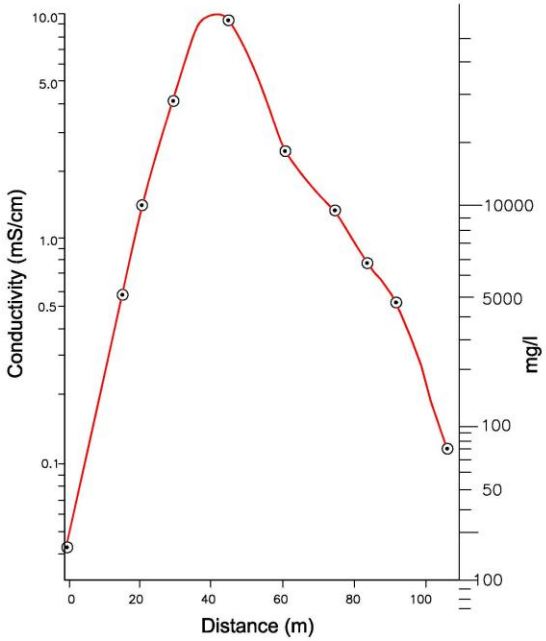
Termite activity

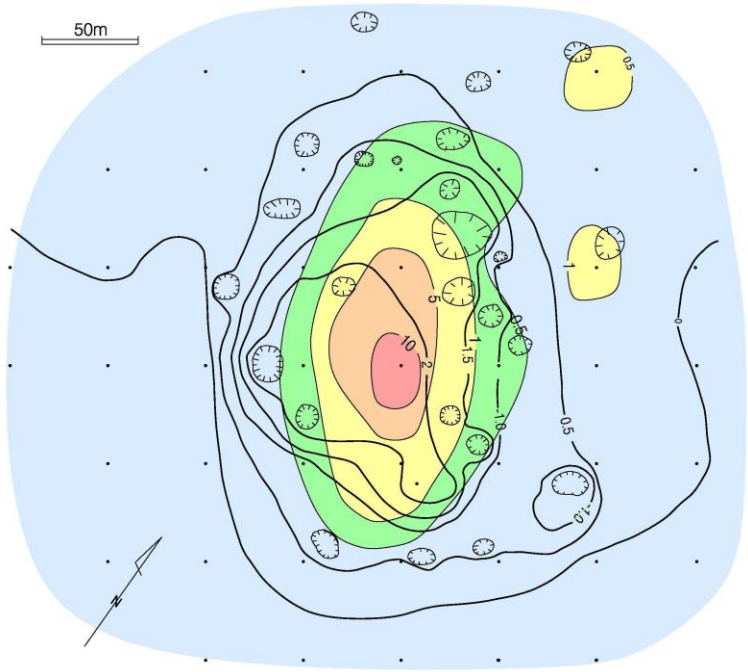

Turret
Pediment


transpiration
transpiration
evaporation
salt crusts
swamp
capillary fringe
WATER TABLE
ground water flow
saline ground water
ground water flow
KEY TO ZONES
swamp vegetation
Phoenix reclinata
Broad leaved evergreen species
Deciduous trees
Hyphaene petersiana
Cynodon dactylon
Sporobolus spicatus


Cover rank
4
0
-4
4
0
-4
20
40
60
80
100
Distance (m)
Woody species
Grass species

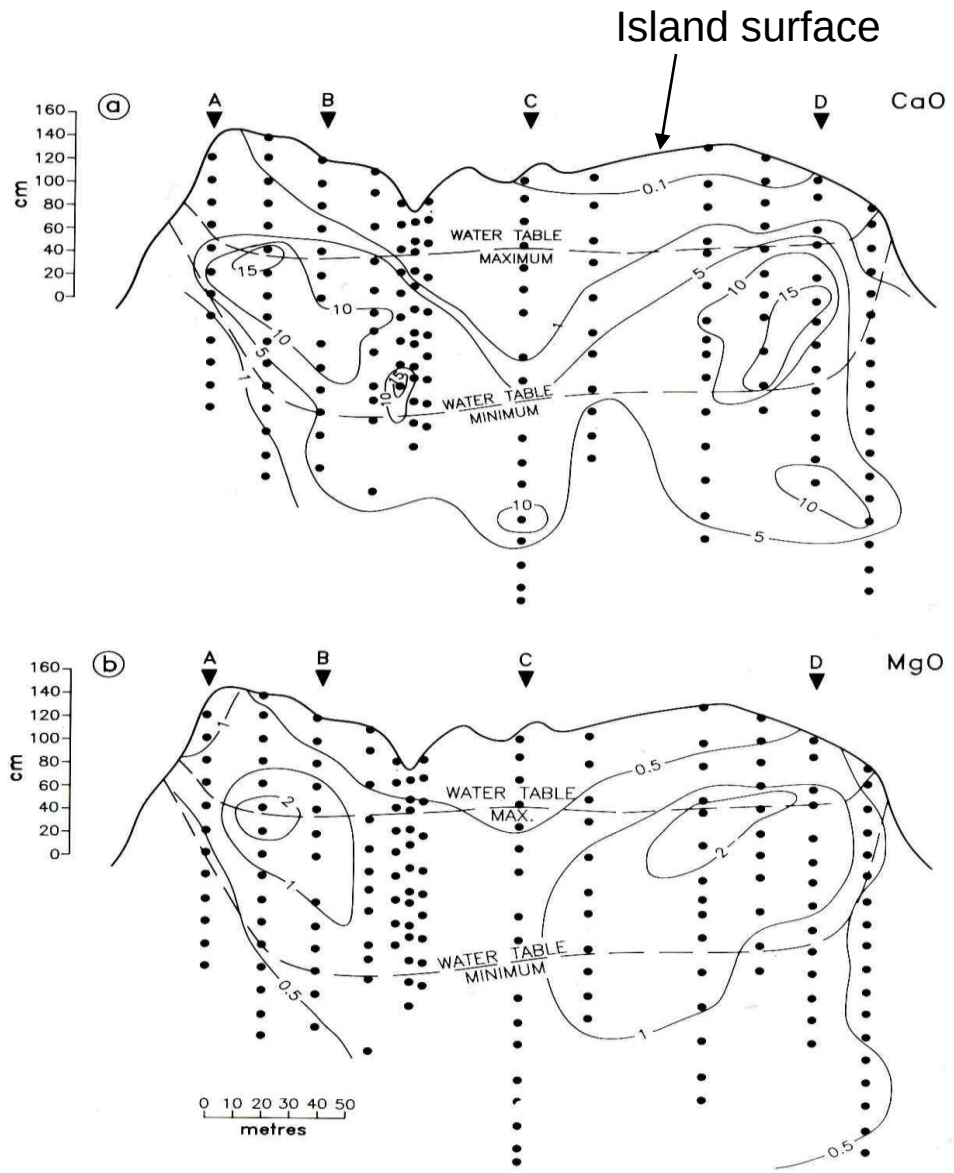

ISLAND
Elevation (cm)
80
60
40
20
0
-20
-40
-60
Swamp
Swamp
Water table
0
20
40
60
80
100
Distance (m)


Conductivity (mS/cm)
10.0
5.0
1.0
0.5
0.1
10000
5000
100
50
100
mg/l
0
20
40
60
80
100
Distance (m)


50m
0.5
1
5
10
2
1.5
1.0
0.5
1.0


LEGEND
Groundwater Conductivity
<0.5
0.5 to 1.0 mS/cm
1.0 to 5.0 mS/cm
5.0 to 10.0 mS/cm
>10.0 mS/cm
Anthill
1.0
Topographic contour above to local datum
Conductivity measurement station

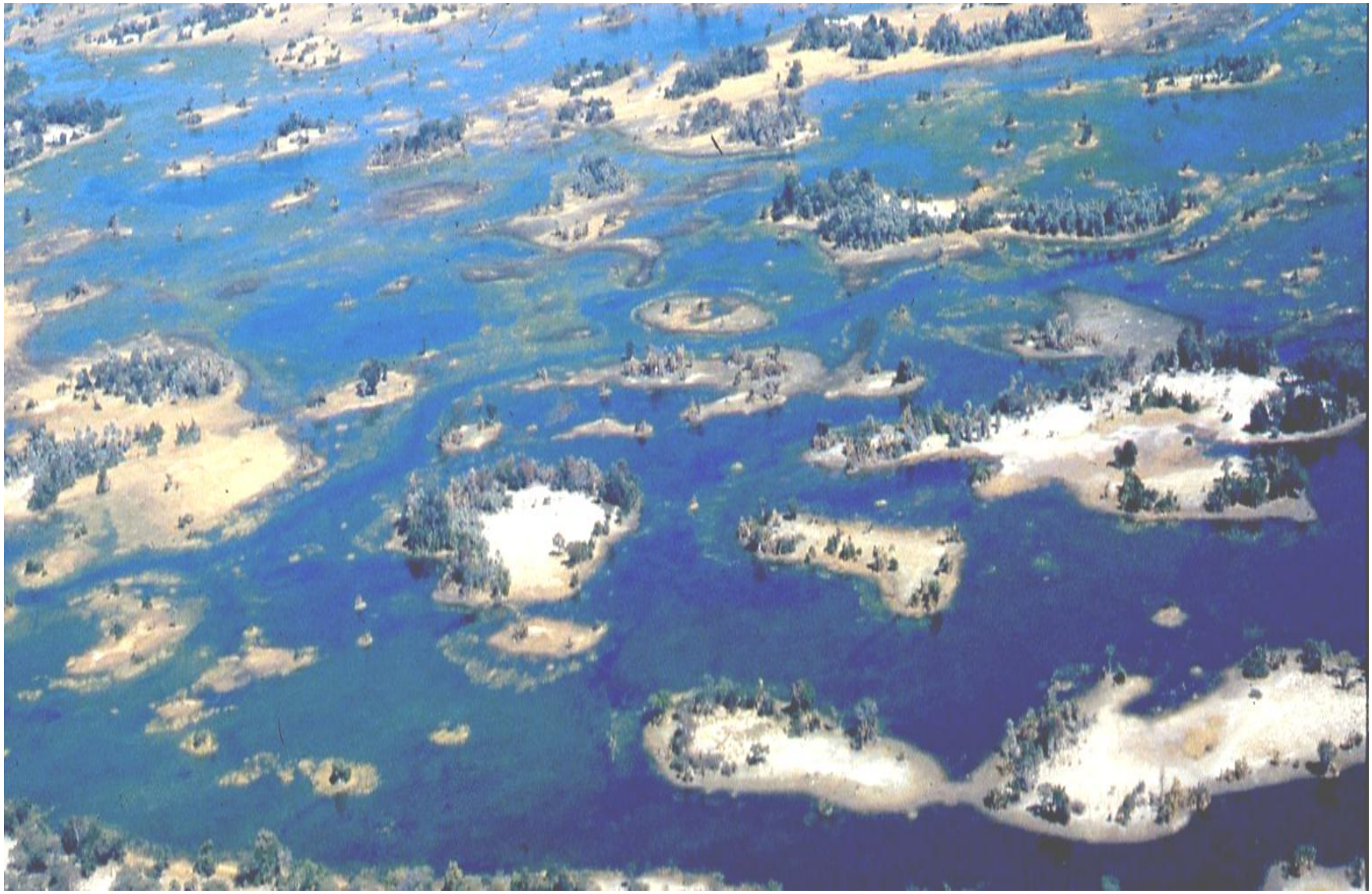
Island growth



Soil calcium content

Soil magnesium content

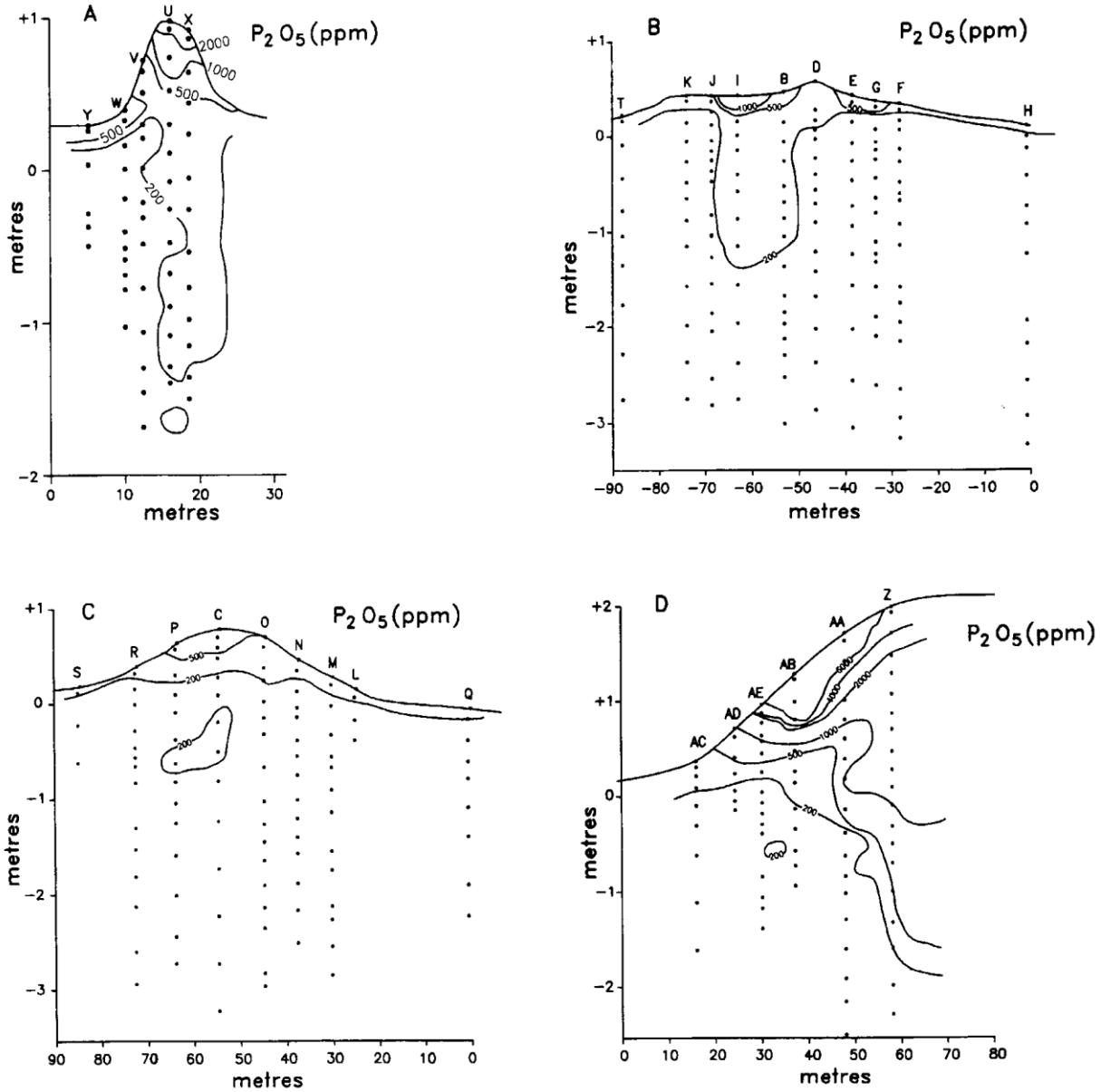
Merging of islands



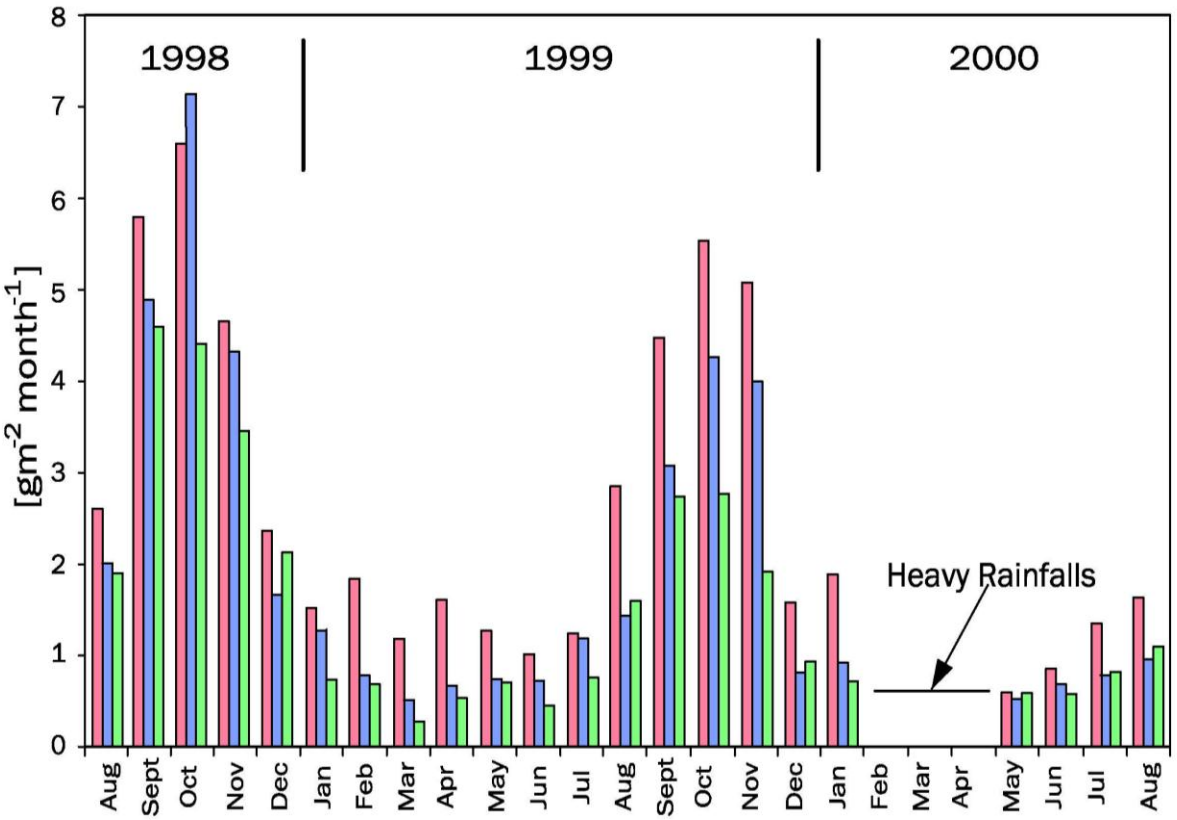

Island diversity
N
© 2012 Google
Image © 2012 DigitalGlobe
5947 ft
Click to see historical imagery from 2005.
Google earth
Imagery Date: 5/5/2011
2005
19°26'50.31" S 22°59'16.33" E elev 3150 ft
Eye alt 28876 ft

Nutrient accumulation on islands

Nutrient accumulation



Continued island growth: Dust accretion



Red – floodplains

Blue – riparian fringe

Green – Island interior

CONCLUSIONS

Initial mound is created by channel inversion or termite activity

Mound is colonized by shrubs and trees – groundwater processing and nutrient accumulation commences

SHORT TERM EFFECTS – DECADES:
salinization of soil leads to vegetation zonation

LONG TERM EFFECTS – MILLENNIA:
- calcite and silica accumulation in the island soils causes expansion;
- Island grows as vegetation traps air-borne dust;
- Islands gradually amalgamate